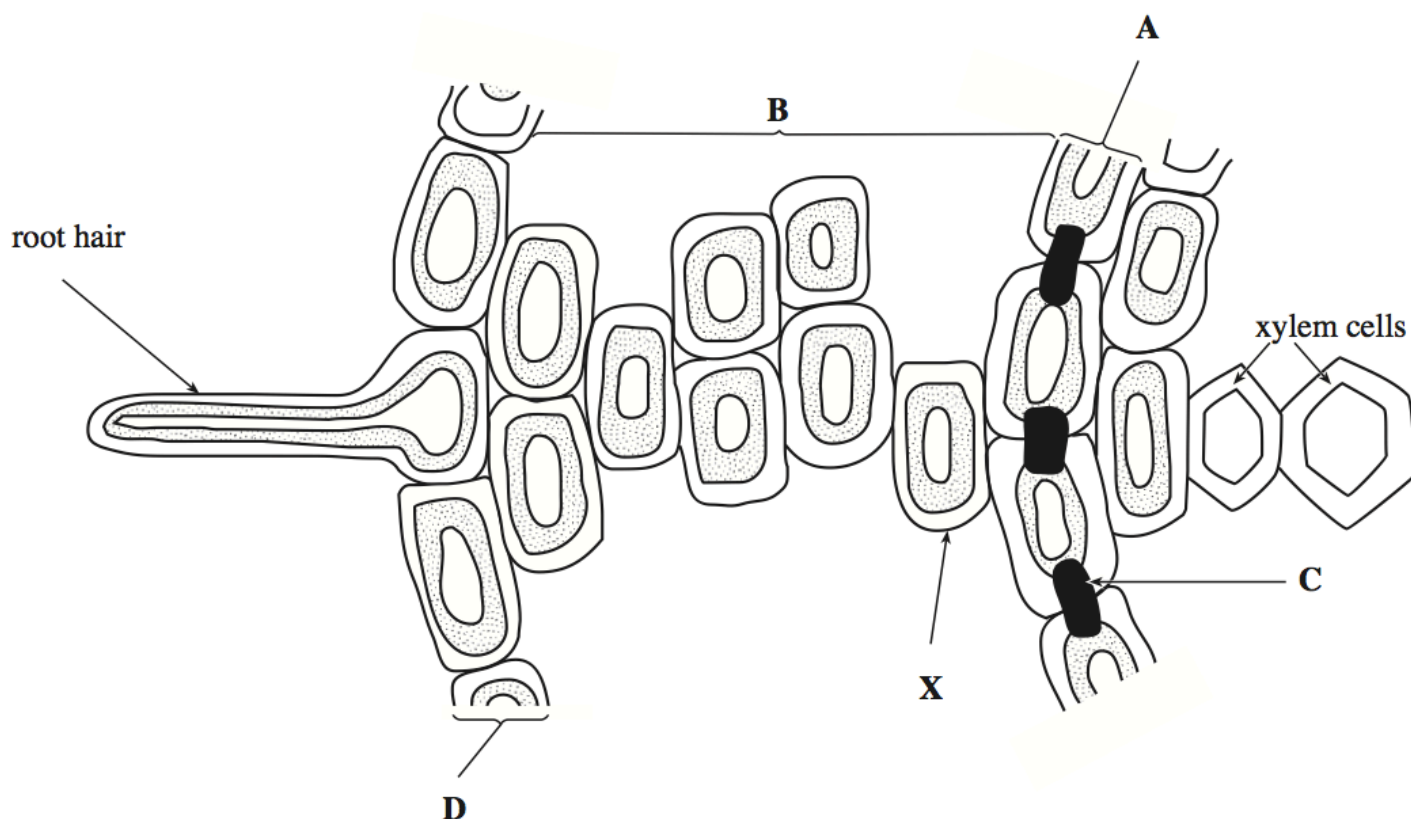


1.

5. The diagram represents part of a transverse section across a young root.



(a) Name the structures labelled

[4]

A, .....

B, .....

C, .....

D, .....

(b) (i) The ion concentration in the root hair is greater than in the soil water. Explain this difference. [1]

.....  
.....

(ii) Name and describe the **two** main pathways by which ions move across B. [4]

.....  
.....  
.....

- (c) (i) The concentration of ions in the cell labelled **X** was found to be  $80 \text{ mmol dm}^{-3}$  and in the soil water surrounding the root it was  $0.16 \text{ mmol dm}^{-3}$ . By how many times had the concentration increased? [1]

.....

- (ii) Why are increases in ion concentration across region **B** important to the functioning of the plant? [2]

.....

.....

- (iii) Structure **C** contains the water-proof substance suberin.  
What effect does this have on the movement of solutions into the root? [1]

.....

- (iv) What is the importance of this effect? [2]

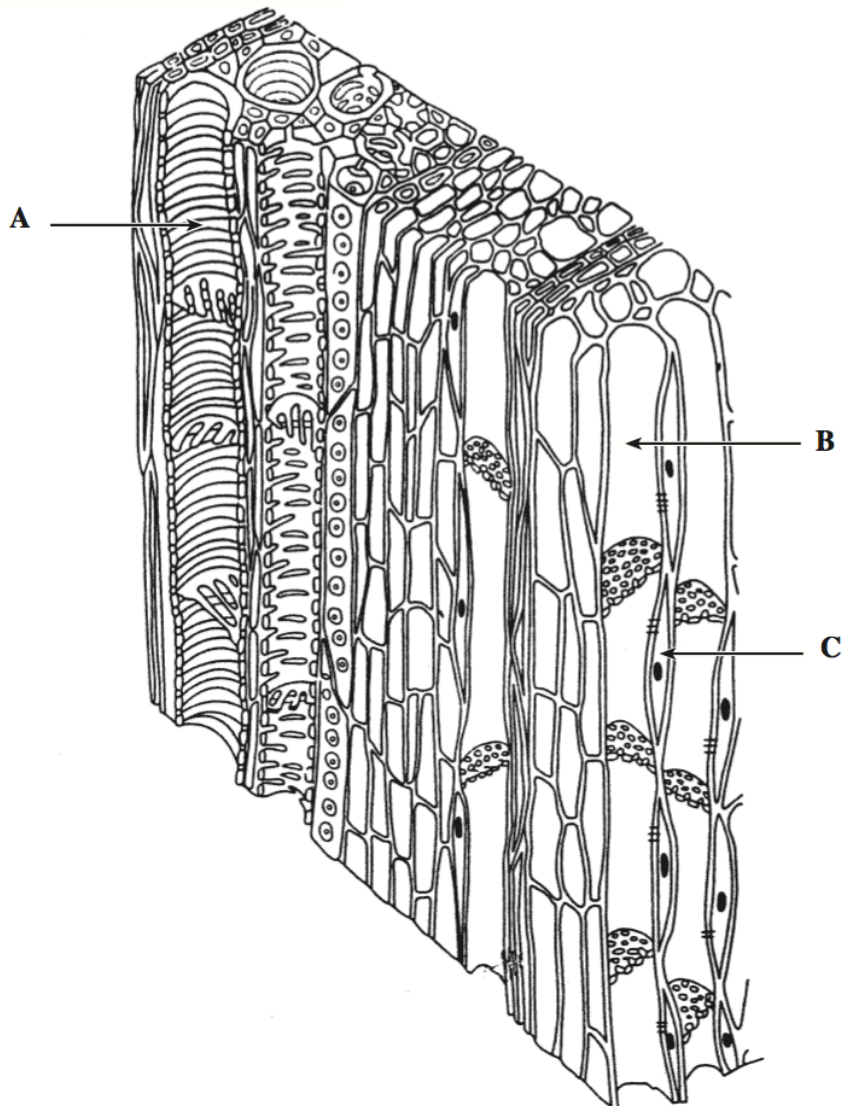
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.....

**(Total 15 marks)**

2.

The diagram below is a three-dimensional drawing of part of a stem.



(a) Identify the cells **A**, **B** and **C** and give a function for each.

[6]

**A** .....

Function .....

.....

**B** .....

Function .....

.....

**C** .....

Function .....

.....

- (b) Cell A has a secondary cell wall which contains the substance lignin. Explain the function of this material in the cell wall. [2]

.....

.....

.....

.....

- (c) Complete the following passage, using **one** of the following, in **each** of the spaces provided. [5]

adhesive,      cohesive,      casparian strip,      apoplast,      symplast,  
hydrophilic,      hydrophobic,      vacuolar pathway,      capillarity.

Water is absorbed into the root mainly through the root hairs. Its movement through the apoplast is prevented by the ..... in the endodermis. Movement through the ..... is aided by the plasmodesmata. The water is pulled upwards by the transpiration pull and this is possible by large ..... forces between the water molecules and ..... forces between the water molecules and the ..... lining of the cells.

**(Total 13 marks)**

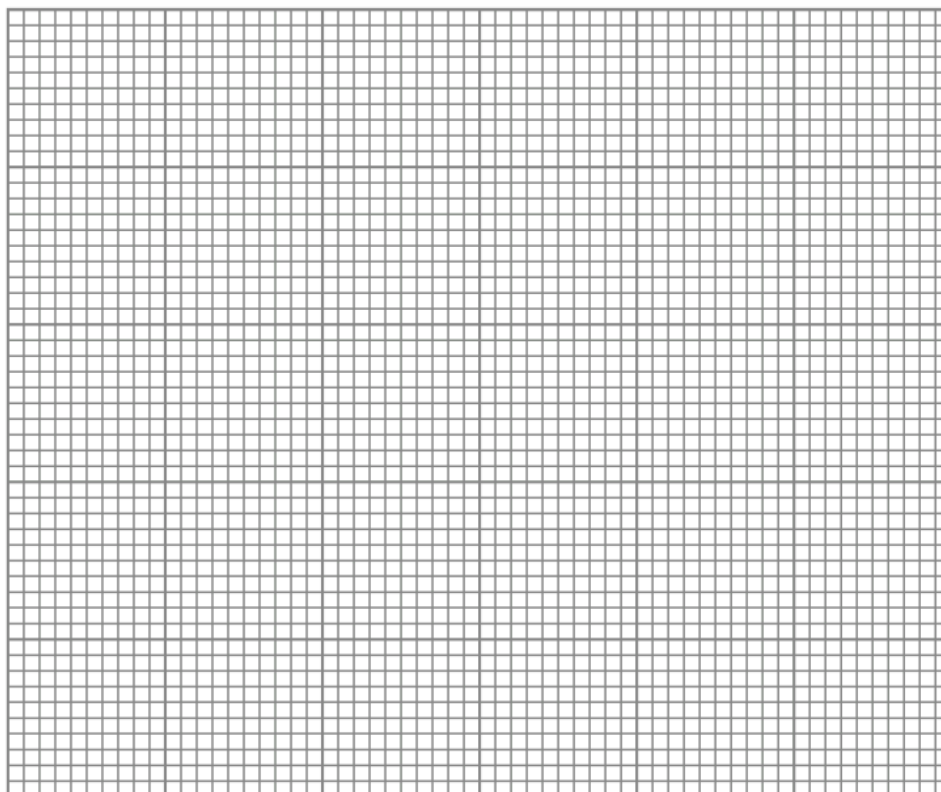
3.

6. The table shows the transpiration rate of a plant, measured at regular intervals over a 20hr period.

Time (hrs)	04.00	08.00	12.00	16.00	20.00	24.00
Rate ( $\text{gh}^{-1}$ )	0.25	1.50	4.00	7.50	3.25	0.75

- (a) Plot these data on the graph paper provided.

[4]



- (b) Describe and explain the difference in the transpiration rate at 0800hrs compared with 1600hrs. [4]

.....

.....

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.....

.....

.....

(c) Under experimental conditions, give **two** ways in which the peak value could be increased. [2]

1. ....

2. ....

(d) The cohesion-tension theory explains the movement of water up the xylem of a plant.

(i) Explain what is meant by *cohesion*. [1]

.....

(ii) Explain how *tension* is generated. [2]

.....

.....

.....

(iii) What additional force helps to support the water molecules in the xylem against the force of gravity? [1]

.....

(e) The values plotted on the graph never fall to zero. This suggests that throughout the 24 hour period a constant additional small force is influencing the upward movement of water.

(i) Name this force. [1]

.....

(ii) Explain how this force is generated. [2]

.....

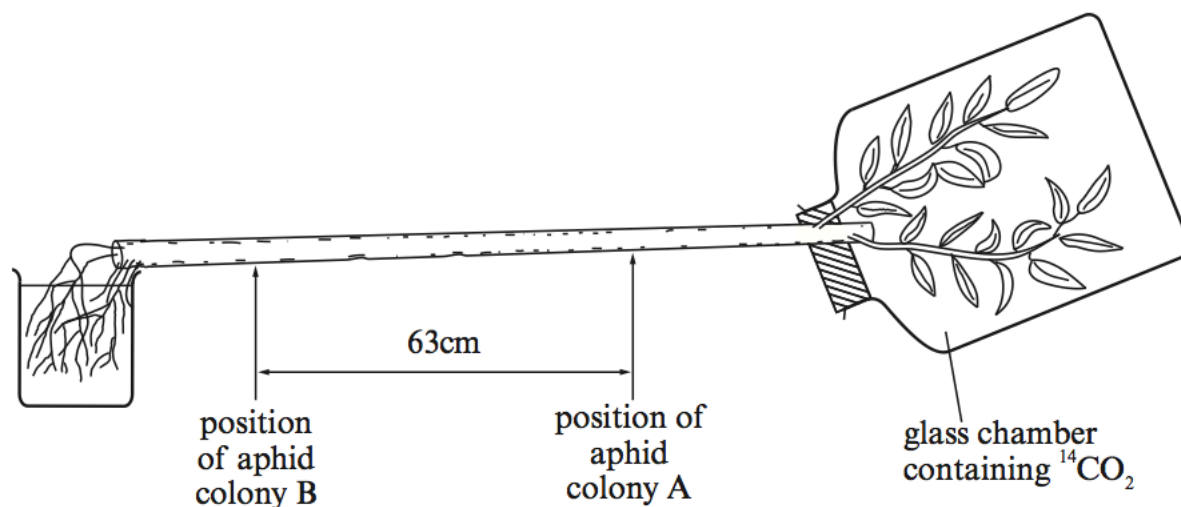
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**(Total 17 marks)**

4.

The diagram shows an experiment in which the leaves of a plant were exposed to radioactive carbon dioxide. Two colonies of aphids (greenfly) were allowed to feed on the stem of the plant and their excreta was collected at regular intervals. This excreta was scanned for radioactivity.



- (a) Radioactivity was first recorded in colony A,  $2\frac{1}{2}$  hours after the start of the experiment. In colony B no radioactivity appeared until five hours after the start of the experiment. Calculate the rate of movement of the radioactive carbon along the stem. [3]

- (b) (i) Explain what is meant by the terms *source* and *sink*. [2]

.....

.....

.....

- (ii) Name a source and a sink shown in the diagram. [2]

.....

.....



(c) (i) Name the radioactive molecule which was transported from source to sink. [1]

.....

(ii) What is the name given to this form of transport in a plant? [1]

.....

(d) Name the tissue and the type of cell where you would expect the greatest amount of radioactivity to be detected. [2]

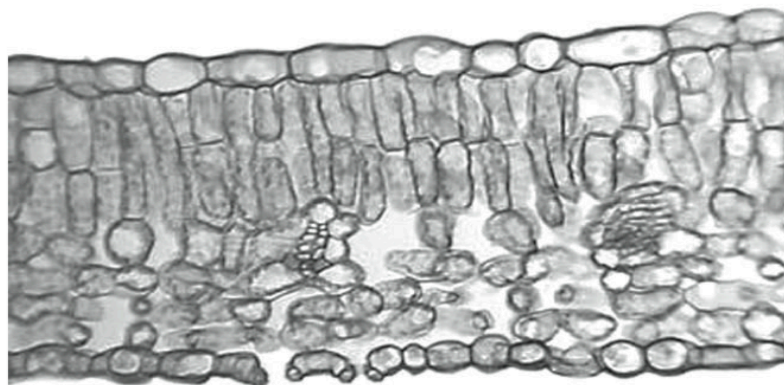
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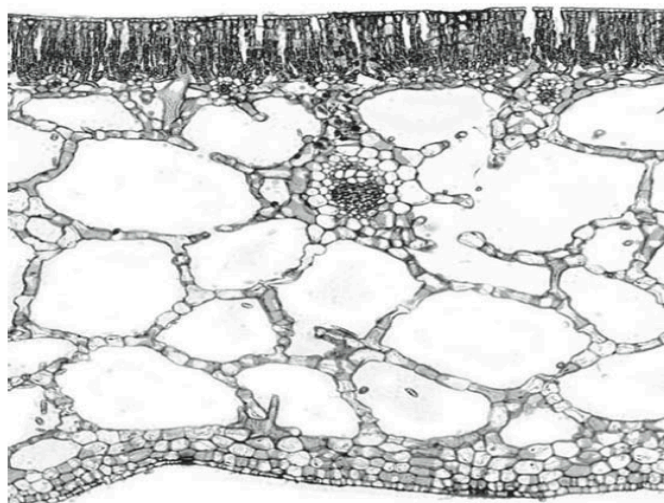
**(Total 11 marks)**

5.

The photographs below show sections of two leaves from two species of plant. *Ligustrum* is a mesophyte plant.



TS *Ligustrum* leaf (Privet)



TS *Nymphaea* leaf (Waterlily)



(a) What type of plant is *Nymphaea*? [1]

(b) Using the information in the photographs, describe **two** visible differences between the two species. [2]

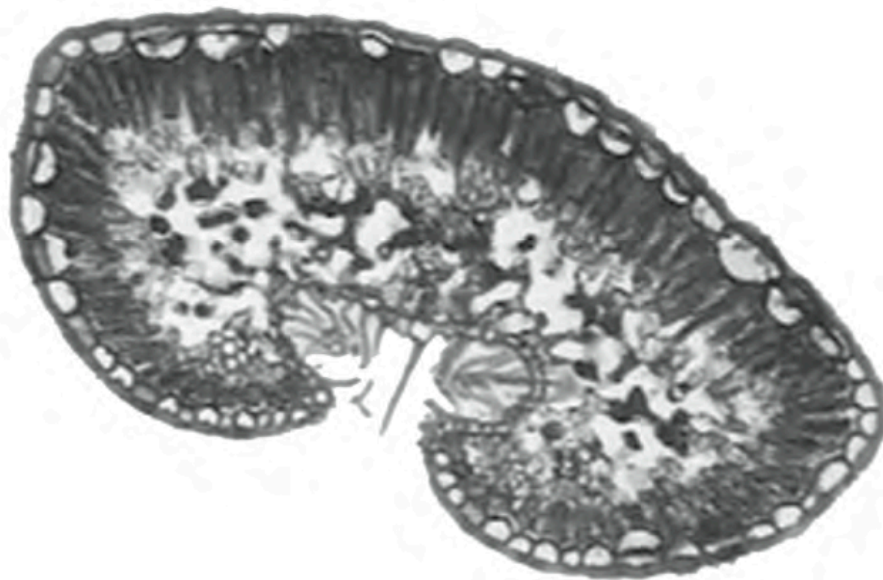
(c) State **three** adaptations of *Nymphaea* for living in an aquatic environment and state why each is important. [3]

(d) Give **one** feature of *Ammophila* (Marram Grass) which shows how it is adapted to its environment. [1]

(Total 7 marks)

6.

The photograph below shows a transverse section through the leaf of heather (*Erica cinerea*). This heather lives in a dry, windy environment.



- (a) (i) State **three** features of the leaf shown above which indicate that it lives in a dry environment. [3]

Feature 1 .....

Feature 2 .....

Feature 3 .....

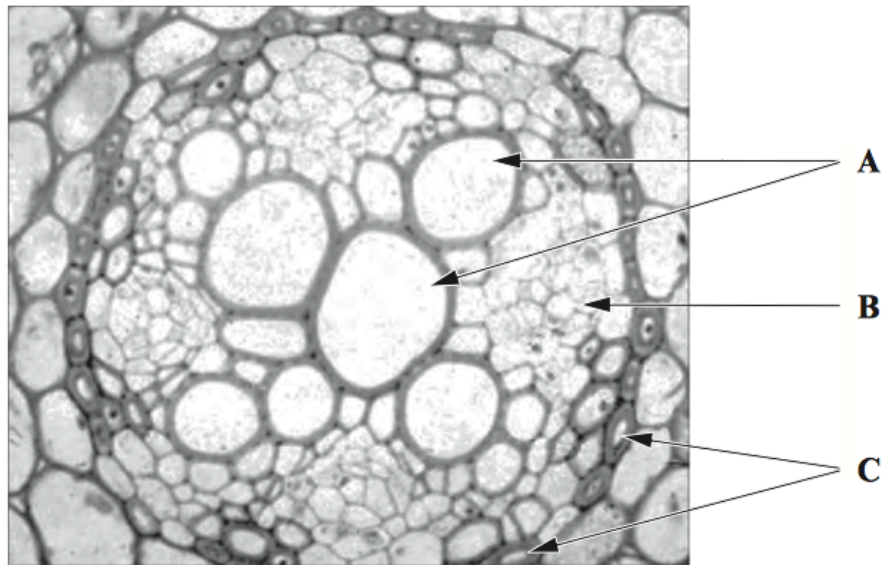
- (ii) Explain how any **one** of these features help *Erica* live in a dry environment. [1]

.....

- (b) What name is given to plants that live in dry environments? [1]

.....

- (c) The diagram below shows a transverse section of a buttercup (*Ranunculus sp.*) root as seen under high power with a light microscope.



- (i) Name tissue **A** and explain its role in the plant. [2]

.....

.....

- (ii) Name tissue **B** and explain its role in the plant. [2]

.....

.....

- (iii) Name cells **C**. [1]

.....

- (iv) Draw a simple longitudinal section of cell C clearly labelling the special feature of this cell. [2]

- (v) Explain how cell C carries out its function in the uptake of water and minerals in the plant. [4]

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**(Total 16 marks)**

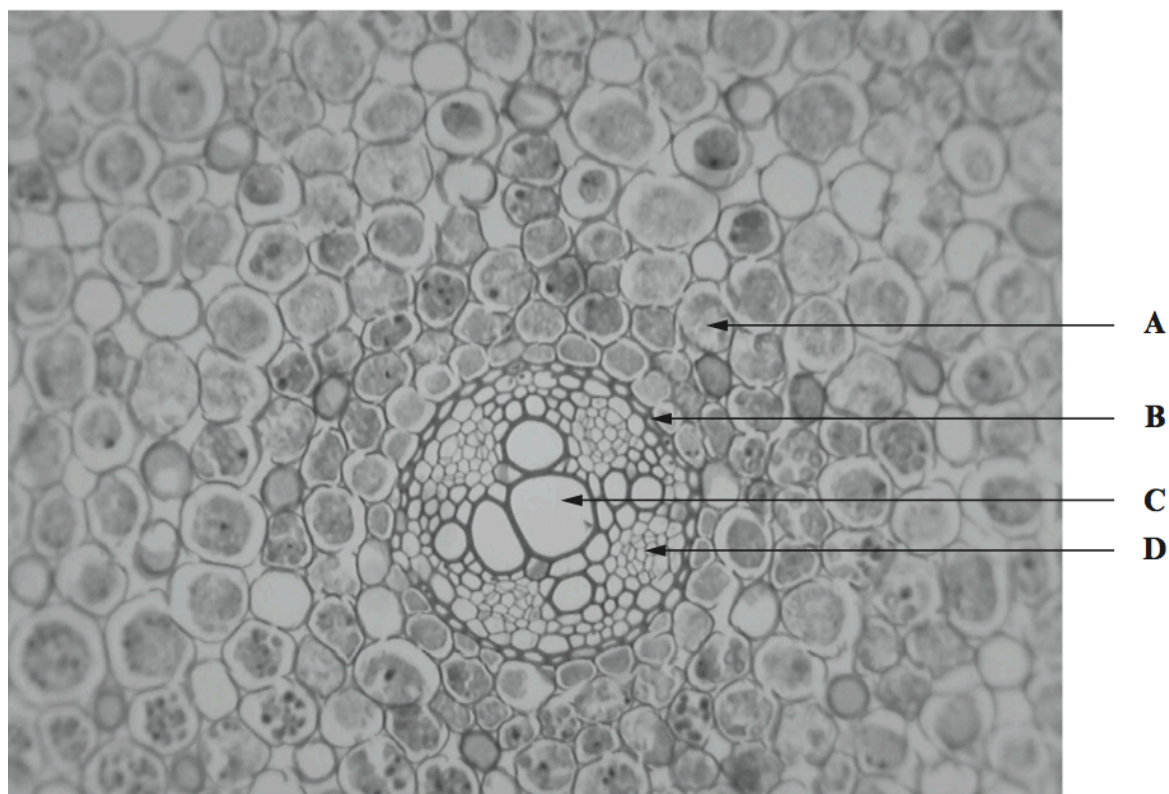
7.

Roots of higher plants contain vascular tissues, the photomicrograph below shows a transverse section through the central part of a buttercup (*Ranunculus sp.*) root.

(a) Name the tissues labelled A-D on the photomicrograph of a root. [2]

A ..... B .....

C ..... D .....



(b) Name the tissue shown in the photomicrograph above which is strengthened with lignin ..... [1]  
has sieve tubes. ....

(c) State the function of (i) sieve tube cells [1]

.....  
.....

(ii) companion cells. [1]

.....  
.....

(d) Some water moves across the root cortex through the vacuolar pathway, from vacuole to vacuole of adjacent cells.

(i) Name and describe **two other** pathways by which water moves across the root cortex. [4]

Name of pathway .....

Description .....

.....

.....

.....

Name of pathway .....

Description .....

.....

.....

.....

(ii) How does the Casparian strip affect the route water takes into the stele? [1]

.....

.....



8.

- (a) Plants carry out the process of transpiration.

State what is meant by the term *transpiration*.

[2]

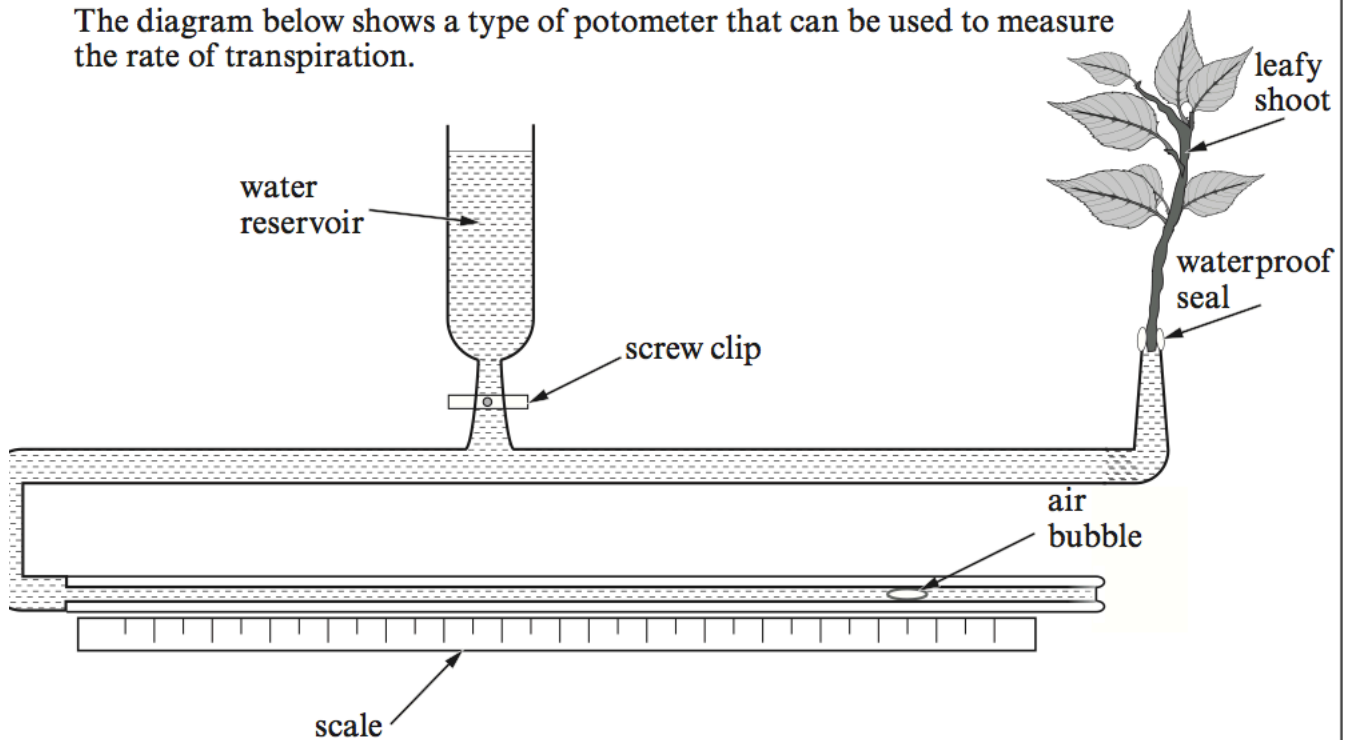
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The diagram below shows a type of potometer that can be used to measure the rate of transpiration.



- (b) State **two** practical measures which should be taken when setting up the apparatus to ensure the potometer functions correctly. Give reasons for your answers. [4]

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(c) Water passes through the xylem of the root and stem of a plant before reaching its leaves.

(i) Name the original source of energy that moves water through a plant. [1]

.....

(ii) Explain how water moves up the xylem. [2]

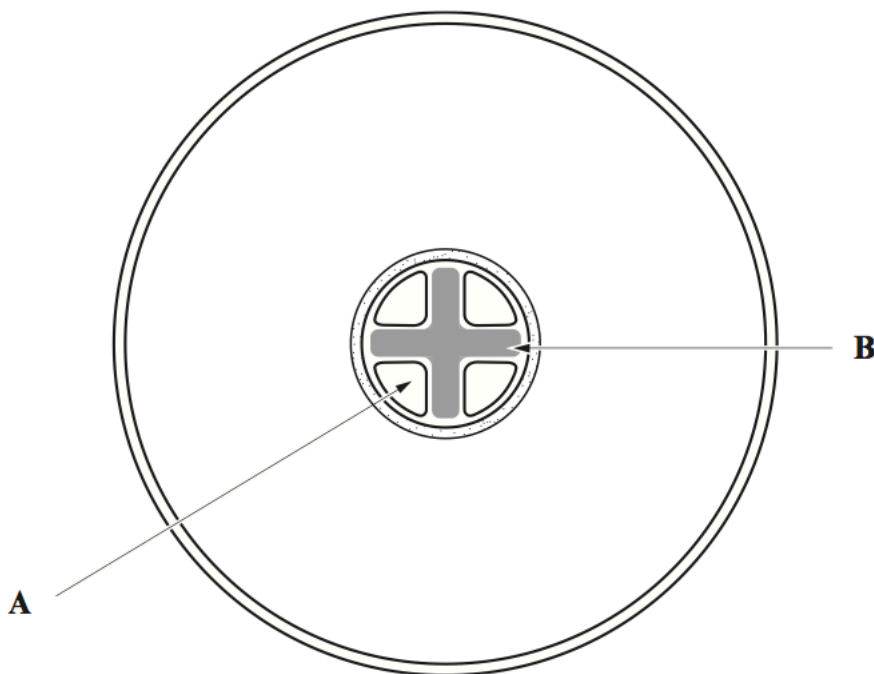
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(d) The diagram below shows the cross section of a root.



(i) Name the **two** tissues labelled **A** and **B** on the diagram above. [2]

**A** ..... **B** .....

(ii) Explain how it is possible to tell that the diagram above is of a root and not a stem. [2]

.....

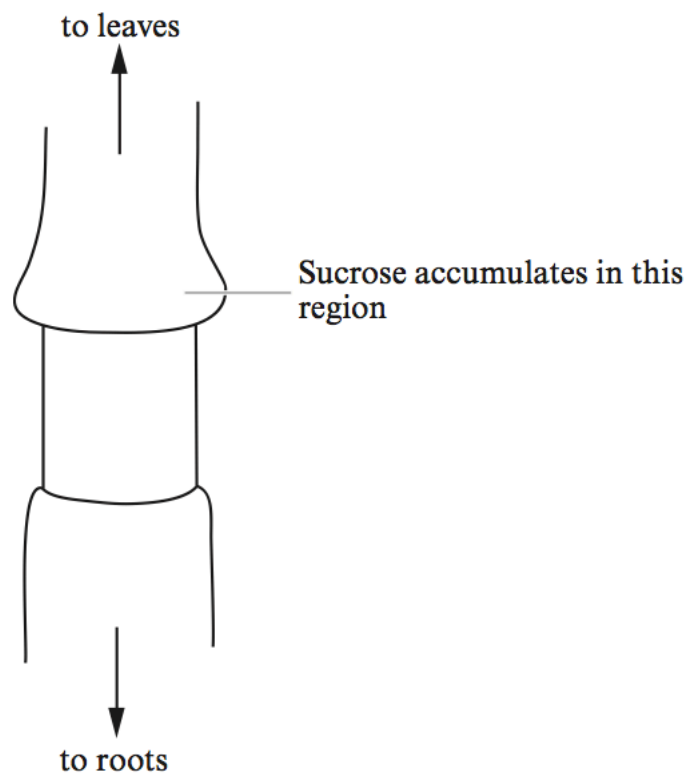
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9.

- (a) The diagram below shows part of a plant stem with the tissue external to the xylem removed, a technique known as ringing.

An accumulation of sucrose was found in the region shown.



- (i) Explain why this accumulation of sucrose occurred. [3]

.....

.....

.....

.....

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.....

.....

- (ii) Name **one** other type of organic molecule that is likely to accumulate with the sucrose. [1]

.....

- (b) If the growing points of the shoot of the plant are removed there is a greater accumulation of sucrose.

Explain why there is a greater accumulation of sucrose.

[2]

- (c) Explain fully the likely effect of the removal of the ring of tissue on the concentration of sucrose **below** the ring.

[3]

10.

- (a) Four Pea (*Pisum sativum*) leaves **A**, **B**, **C** and **D** were removed from a healthy plant and treated by applying a thin layer of grease to their upper and lower surfaces. The leaves were then placed in an incubator at 60°C and weighed every two hours until there was no further change in mass.

The results are shown in the table below.

leaf	grease application (surface)	starting mass of leaf (g)	final mass of leaf (g)	change in mass (g)	percentage change in mass (%)
<b>A</b>	upper and lower	12.4	11.9	– 0.5	4.0
<b>B</b>	upper only	13.6	11.2		
<b>C</b>	lower only	13.8	12.7	– 1.1	8.0
<b>D</b>	neither	9.3	6.2	– 3.1	20.5

- (i) Complete the table above by calculating the change in mass and percentage change in mass for leaf **B**.  
Use the space below for your calculation. [2]

- (ii) What does the data reveal about the distribution of stomata on the surfaces of the leaves? [3]

.....

.....

.....

.....

.....

- (iii) Why were the leaves re-weighed 'until there was no further change in mass'? [1]

.....

.....

(b) The table below gives the stomatal densities of three other plant species.

species	number of stomata/cm <sup>2</sup>	
	upper epidermis	lower epidermis
potato ( <i>Solanum tuberosum</i> )	5 100	16 100
bean ( <i>Phaseolus vulgaris</i> )	4 000	28 100
marram grass ( <i>Ammophila sp</i> )	1 200	0

- (i) Marram grass is adapted to grow in dry conditions. State the term used to describe plants that are adapted for dry conditions. [1]

.....

- (ii) Marram grass exhibits leaf rolling. With reference to the **data** in the table above, suggest how Marram grass has adapted its distribution of stomata to conserve water. [3]

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- (iii) State **two** further structural adaptations shown by Marram grass which help it to survive in dry conditions. [2]

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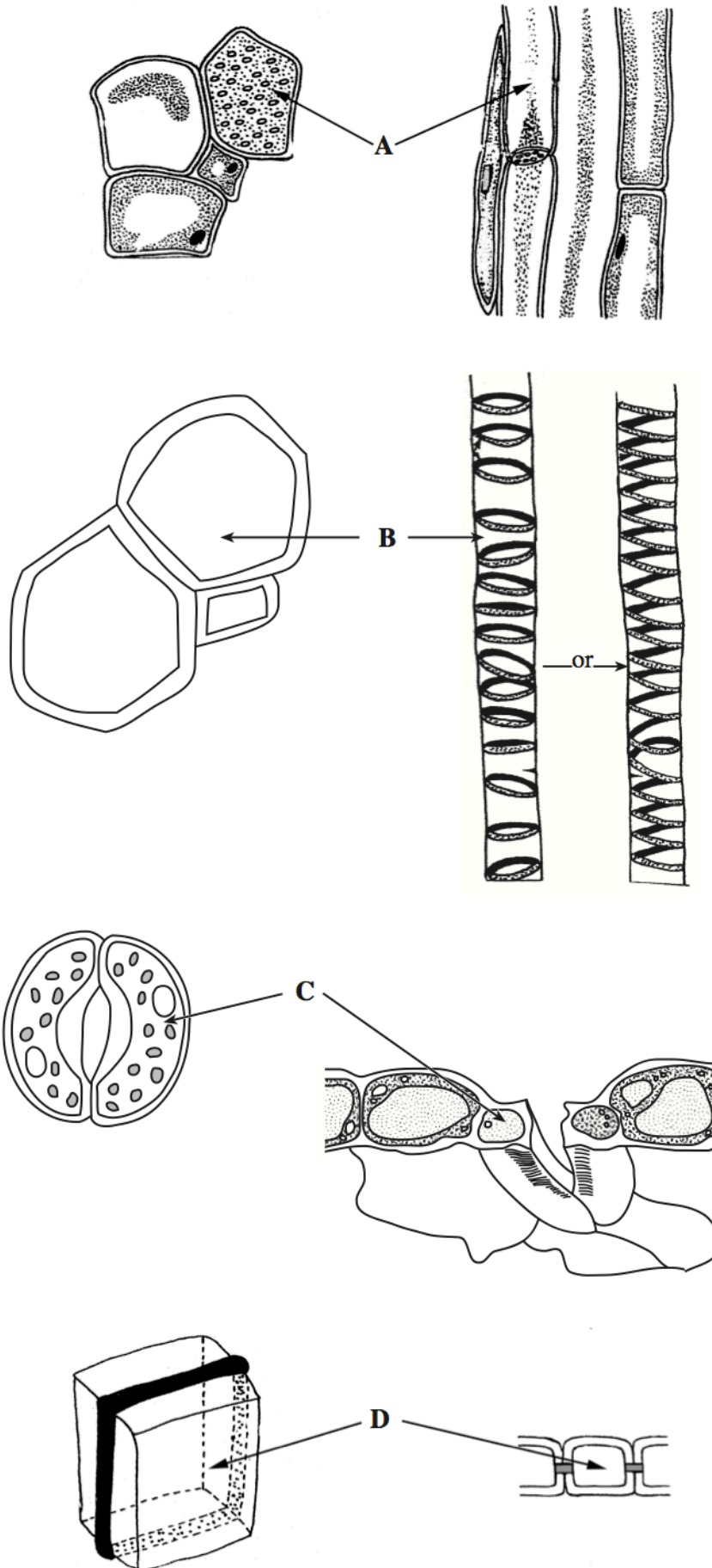
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11.

The diagrams show different views of **four** types of plant cells labelled **A** to **D**.



(a) Identify these cells in the table provided, and give the function of each cell. [8]

<i>Cell type</i>	<i>Name of cell type</i>	<i>Function of cell</i>
<b>A</b>		
<b>B</b>		
<b>C</b>		
<b>D</b>		

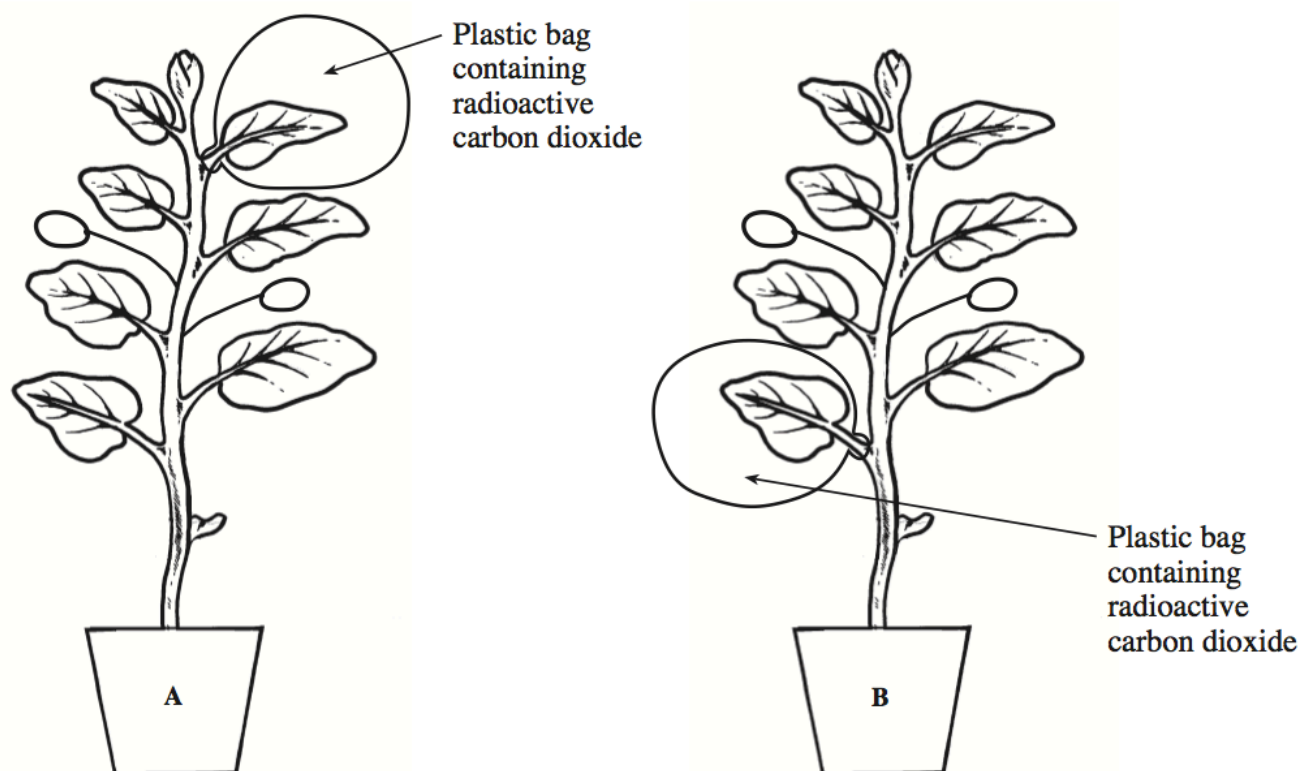
(b) State the plant organ where cell **D** is found. [1]

.....

**(Total 9 marks)**

12.

An experiment was carried out to investigate the translocation of carbohydrate in a plant species. Selected leaves were allowed to photosynthesise in the presence of radioactive carbon dioxide for 30 minutes by securing plastic bags over the leaves. The treatment was applied to two plants of the same species that were producing fruit. The plastic bag was then removed from the plants which were left for 24 hours. The radioactivity of different parts of the plants was then measured.



Treated leaf on upper part of plant.

Treated leaf on lower part of plant.

- (a) Suggest why the plants were left for 24 hours before the parts of the plants were analysed. [1]

- (b) The quantity of radioactivity found in various parts of the plants are shown in the table.

Parts of plants	Radioactivity (counts min <sup>-1</sup> )	
	Plant A (leaf on upper part of stem treated)	Plant B (leaf on lower part of stem treated)
Untreated leaf	230	170
Radioactive CO <sub>2</sub> treated leaf	11 200	11 300
Shoot tip	1 125	760
Stem	810	1 160
Fruit pod	9 050	4 520
Roots	850	2 700

- (i) Given that the total radioactivity recorded in plant **A** was 23 265 counts min<sup>-1</sup>, calculate the percentage radioactivity found at [2]

I. the fruit pod;

.....

II. the shoot tip.

.....

- (ii) Suggest an explanation for these results. [2]

.....

.....

- (iii) What are the **quantitative** differences between the pattern of radioactive carbohydrate translocation in the fruit pod and roots of plant **A** compared with those of plant **B**. [2]

.....

.....

- (iv) Name a *source* and a *sink* in this experiment. [1]

Source .....

Sink .....

- (v) What do the results suggest about the direction of movement between source and sink in plant **A** compared with plant **B**. [1]

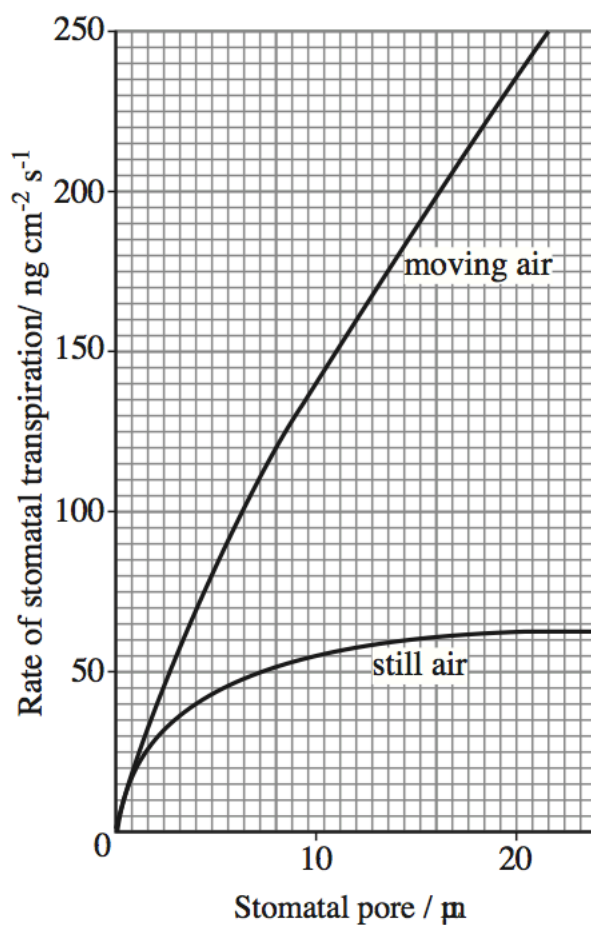
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(Total 9 marks)

13.

- (a) The graph shows the relationship between the rate of transpiration and the diameter of the stomatal pores in still and moving air.



- (i) Describe the relationship between the rate of transpiration and the stomatal diameter in still air. [3]

.....

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- (ii) Explain the differences between transpiration rates in still and moving air. [3]

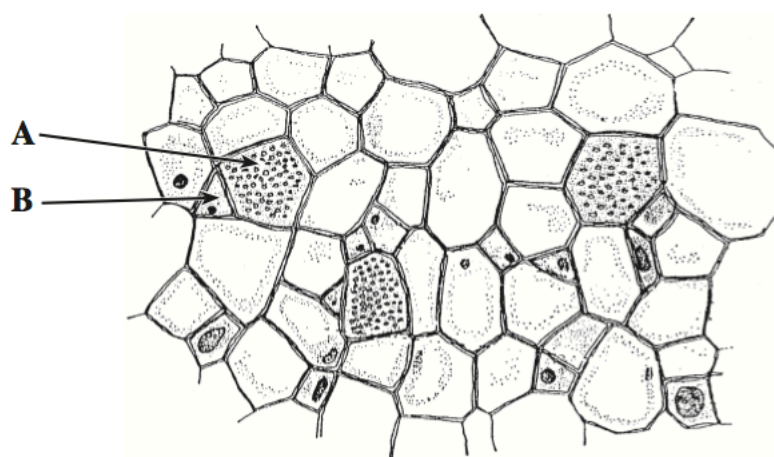
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(b) The diagram shows a transverse section (TS) through the phloem of a plant stem.



(i) Name the cell types labelled **A** and **B**. [2]

**A** .....

**B** .....

(ii) Describe the function of the phloem. [3]

.....

.....

.....

.....

(iii) In the table indicate with a tick (✓) if the structure is present in cells **A** and **B**, or a cross (X) if the structure is absent. [4]

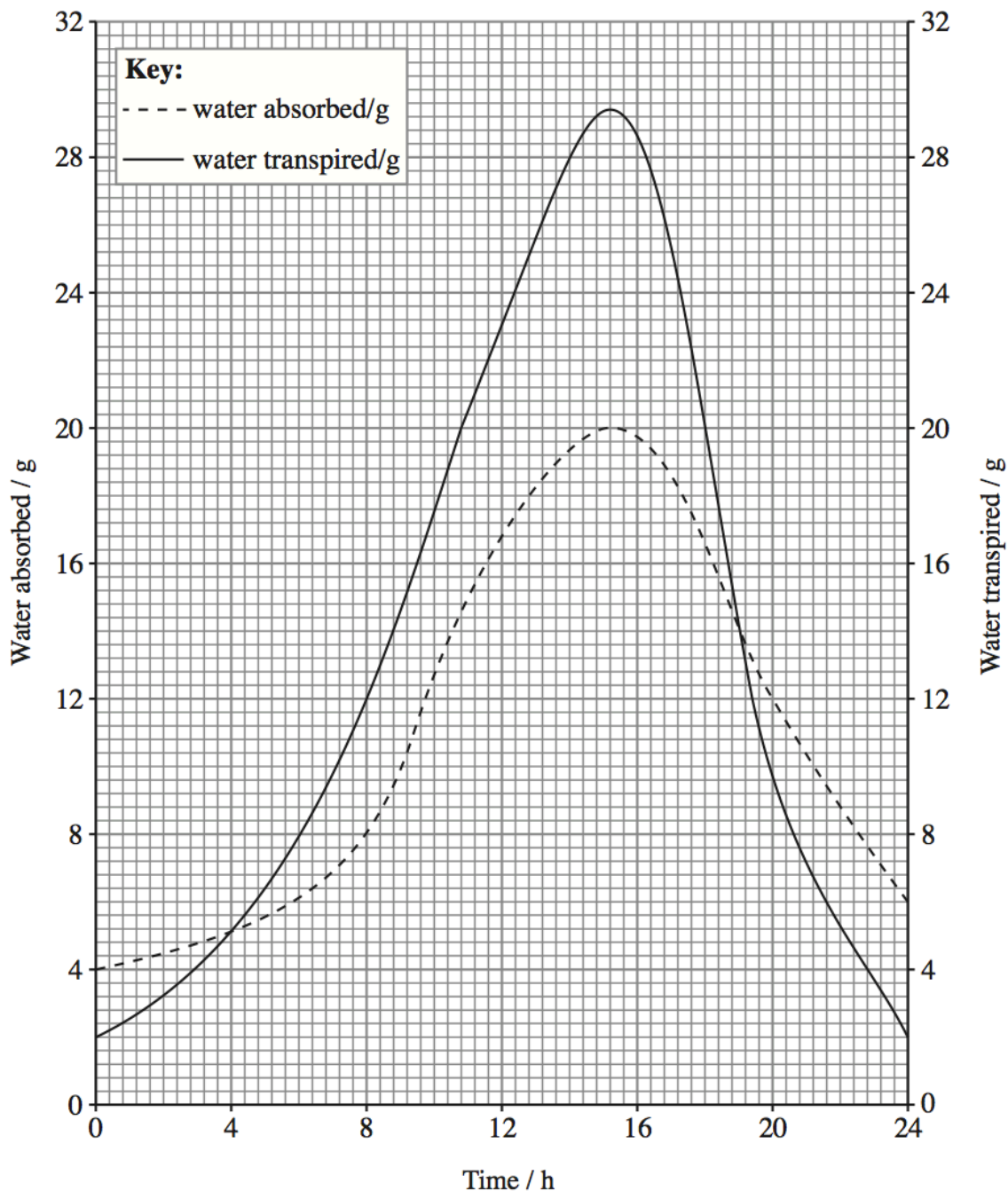
<i>Structure</i>	<i>cell A</i>	<i>cell B</i>
nucleus		
chloroplast		
plasmodesmata		
cytoplasm		

(Total 15 marks)



14.

The graph below shows how the rates of transpiration and water absorption of a plant changed over a 24 hour period.



- (a) (i) Compare the rates of transpiration and water absorption over the 24 hour period. [3]

.....

.....

.....

.....

- (ii) By how many times does the rate of water absorption increase from its lowest point to its highest point? Show your working. [2]

.....

.....

- (iii) Between which times is the plant most likely to wilt? Explain your answer. [4]

Times .....

Explanation .....

.....

.....

- (b) Briefly, describe the processes involved in the opening of the stomatal pores. [4]

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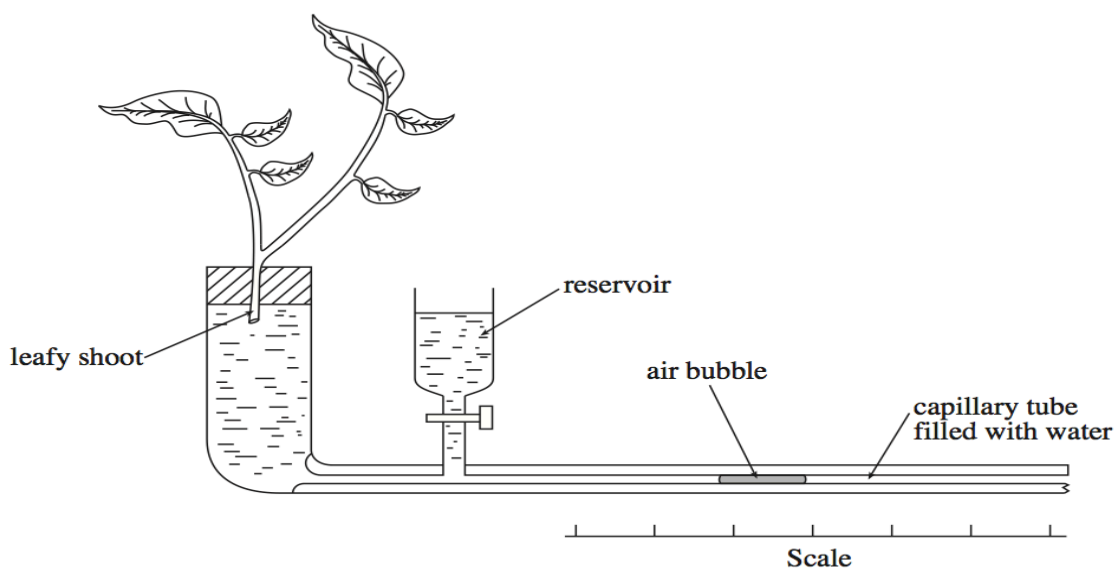
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**(Total 13 marks)**

**15.**

A student used the apparatus shown below to estimate the rate of transpiration in a leafy shoot.



(a) (i) Name this piece of apparatus. [1]

.....

(ii) What exactly does the apparatus measure? [1]

.....

(iii) What is the purpose of the air bubble? [1]

.....

(b) (i) What **two** steps would you take to assemble this apparatus correctly? [2]

.....

.....

.....

(ii) State the function of the reservoir. [1]

.....

(c) Describe how you would use the assembled apparatus to measure the effect of wind speed on transpiration rate. [3]

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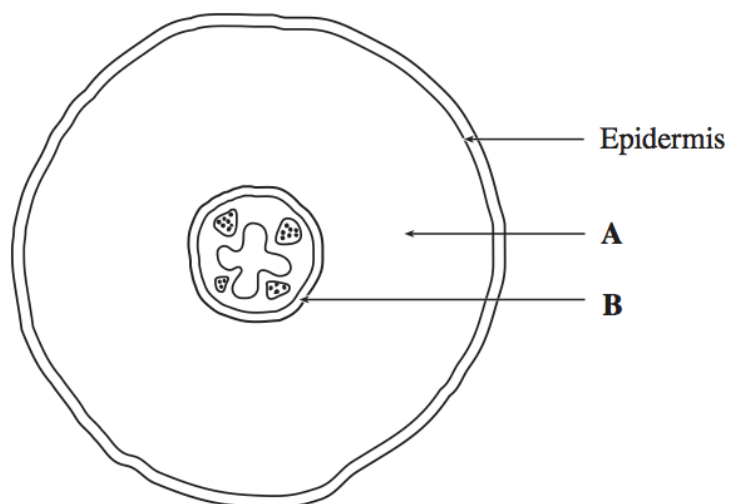
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**(Total 9 marks)**

16.

The diagram represents a transverse section of a root as seen using a light microscope.



- (a) (i) In some areas of the root, epidermal cells are specialised for the uptake of water and mineral ions. In the space below draw an outline diagram to show the shape of **one** cell from this region. [1]

- (ii) State **two** ways in which this cell is adapted for the uptake of water and mineral ions. [2]

.....

.....

- (b) State the parts of the cell in region **A** which are involved with the: [2]

Apoplast pathway, .....

Symplast pathway. ....

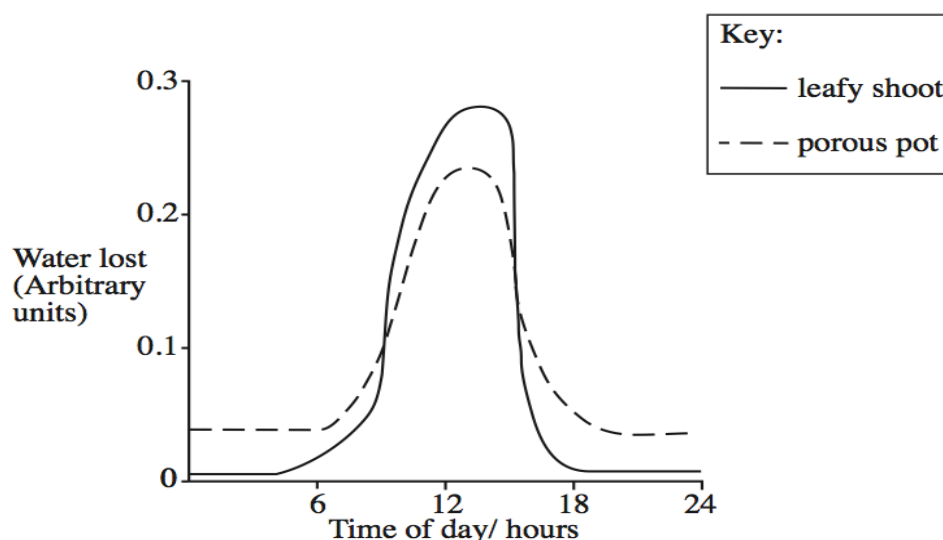
- (c) State how the cells in region **B** are structurally adapted to their function. [2]

- (d) Fungal spores which cause Dutch Elm disease are introduced into the xylem vessels in the trunk of the tree by beetles. Suggest why these spores do not travel to the roots. [1]

(Total 8 marks)

17.

- (a) A porous pot filled with water will lose water through its walls. A pot such as this may be connected to a potometer in the same way as a leafy shoot. The graphs below compare water lost by transpiration from a leafy shoot with that lost by evaporation from a porous pot (atmometer) during a summer's day and night.

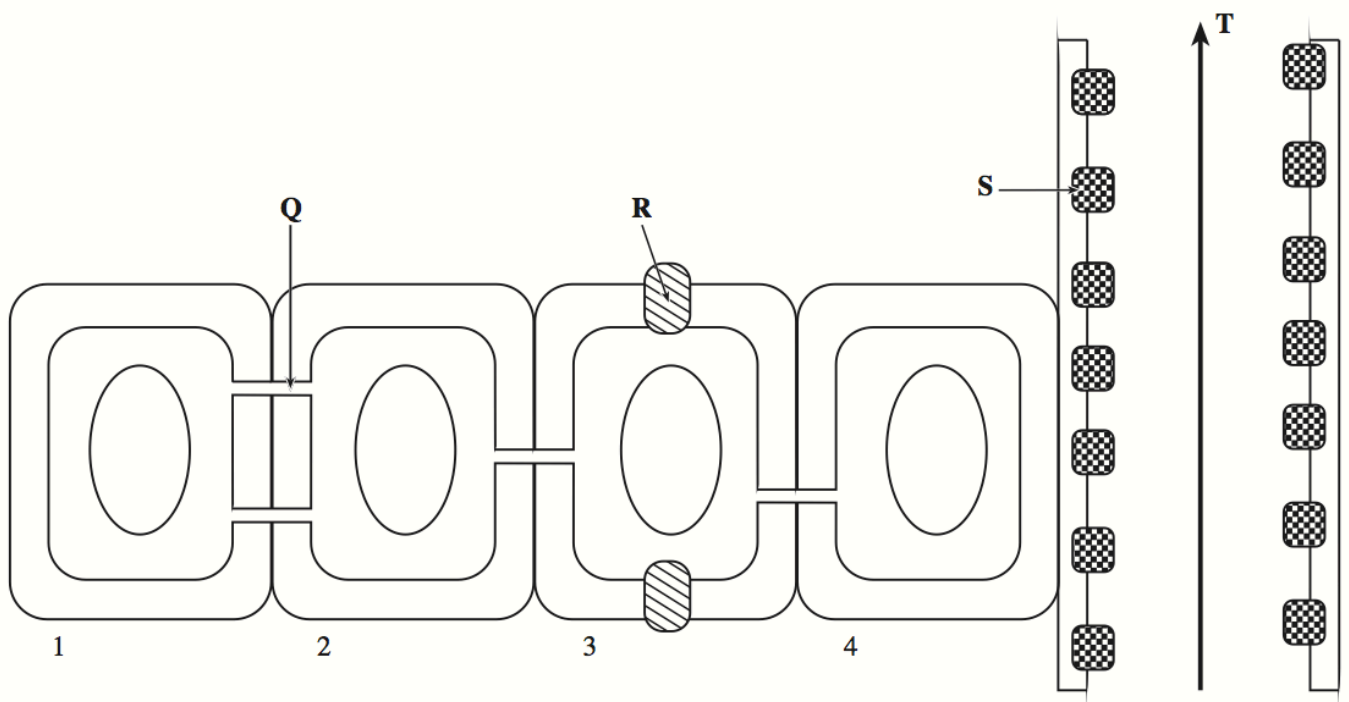


- (i) Describe the difference between the water loss in the leafy shoot and the porous pot during the hours of darkness. [1]

- (ii) The leafy shoot and the porous pot were kept in the same location. Using information from the graphs name a factor that affects transpiration but not evaporation. [1]

- (iii) Explain why the factor you named in part (ii) affects transpiration in the leafy shoot but not evaporation from the porous pot. [2]

(b) The diagram shows adjacent cells from the root of a plant in longitudinal section.



(i) Name structures **Q** and **R**.

[2]

**Q** ..... **R** .....

(ii) Explain how the loss of water molecules from leaves causes water to flow as indicated by arrow **T**.

[2]

(iii) Using a series of arrows, draw and clearly label the **apoplast** pathway between cells 1 and 3 on the diagram above.

[1]

(iv) Using a series of arrows, draw and clearly label the **symplast** pathway between cells 1 and 3 on the diagram above.

[1]

(v) Structures **R** and **S** are made of two different substances that share a physical property. What property do these substances share?

[1]

(vi) Why is this property important for the function of **R**?

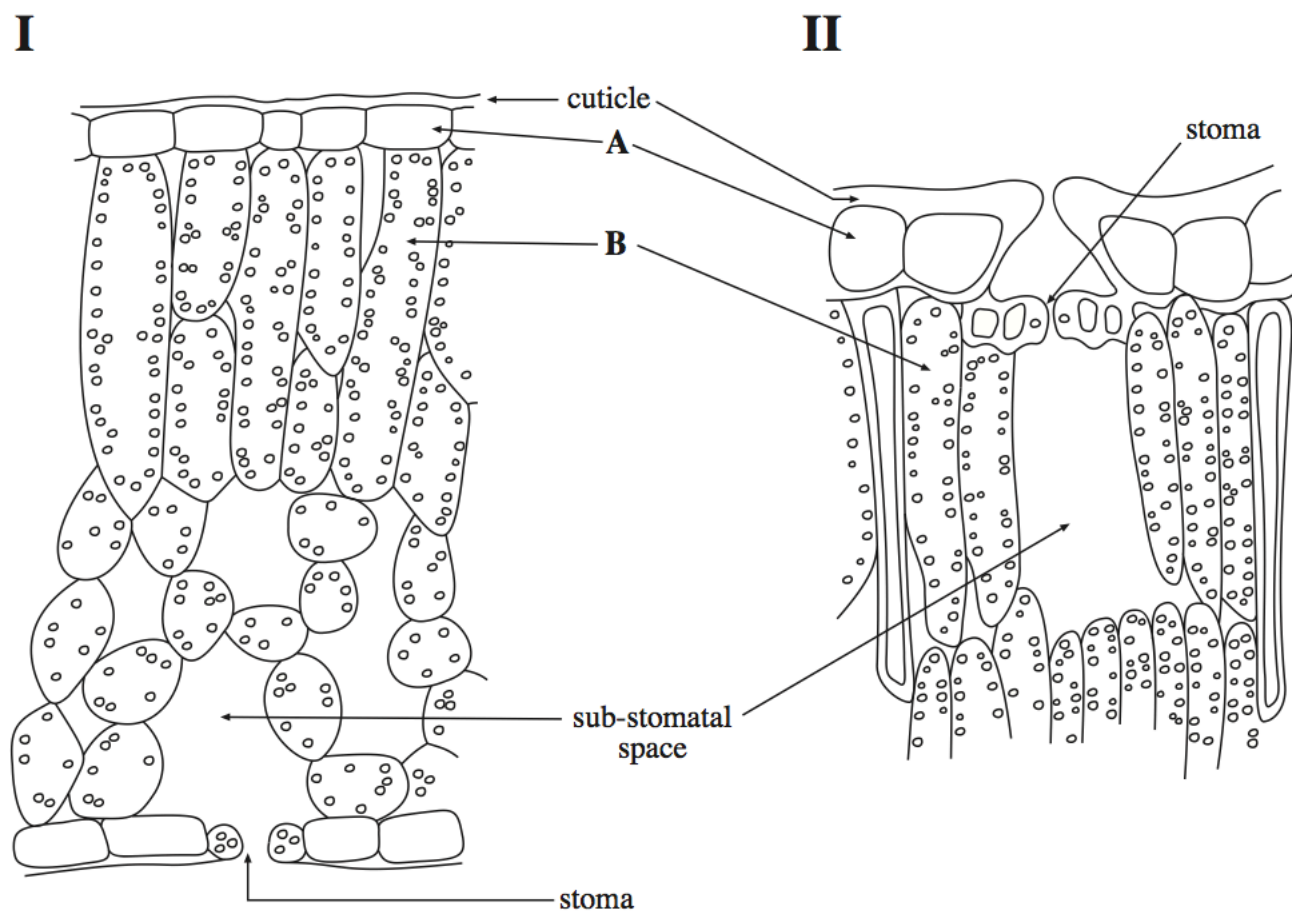
[1]

(Total 12 marks)



18.

The diagrams show sections through the leaves of two different plants, labelled **I** and **II**.



(a) Name the cells labelled **A** and **B**. [2]

**A** .....

**B** .....

(b) (i) Suggest which of these leaves has a lower rate of transpiration. [1]

.....

(ii) Give **two** features, shown in the diagrams, which support your choice. [2]

.....  
 .....  
 .....

(c) Suggest which leaf is likely to have the greatest surface area to volume ratio. [1]

.....

(d) (i) Describe how you would expect the rate of transpiration in a typical leaf to change over a 24 hour period. [3]

.....  
.....  
.....

(ii) Give an explanation for the opening and closing of stomata which bring about these changes. [3]

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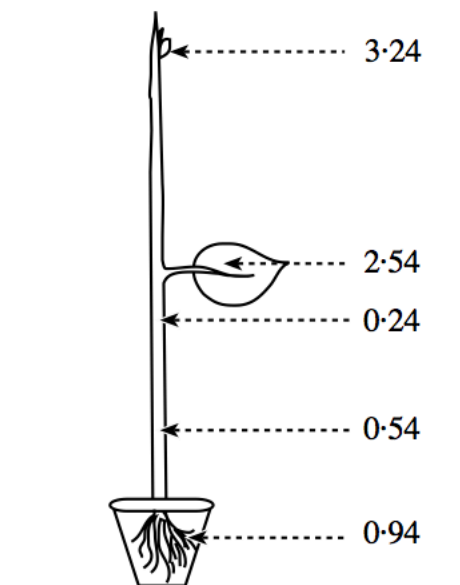
(iii) Give **one other** factor that might contribute to these daily changes in transpiration rate. [1]

.....

**(Total 13 marks)**

19.

An experiment was performed in which  $^{14}\text{CO}_2$  was applied to a single leaf of a plant kept in the light. The distribution of the  $^{14}\text{C}$  throughout the plant was subsequently monitored. The diagram shows the distribution of  $^{14}\text{C}$  throughout the plant (in arbitrary units).



(a) State the name of the substance in which the  $^{14}\text{C}$  will be transported in the stem. [1]

(b) Explain how the results demonstrate that bi-directional flow occurs in the stem. [2]

(c) (i) Explain the relatively high value of  $^{14}\text{C}$  found at the top of the stem. [2]

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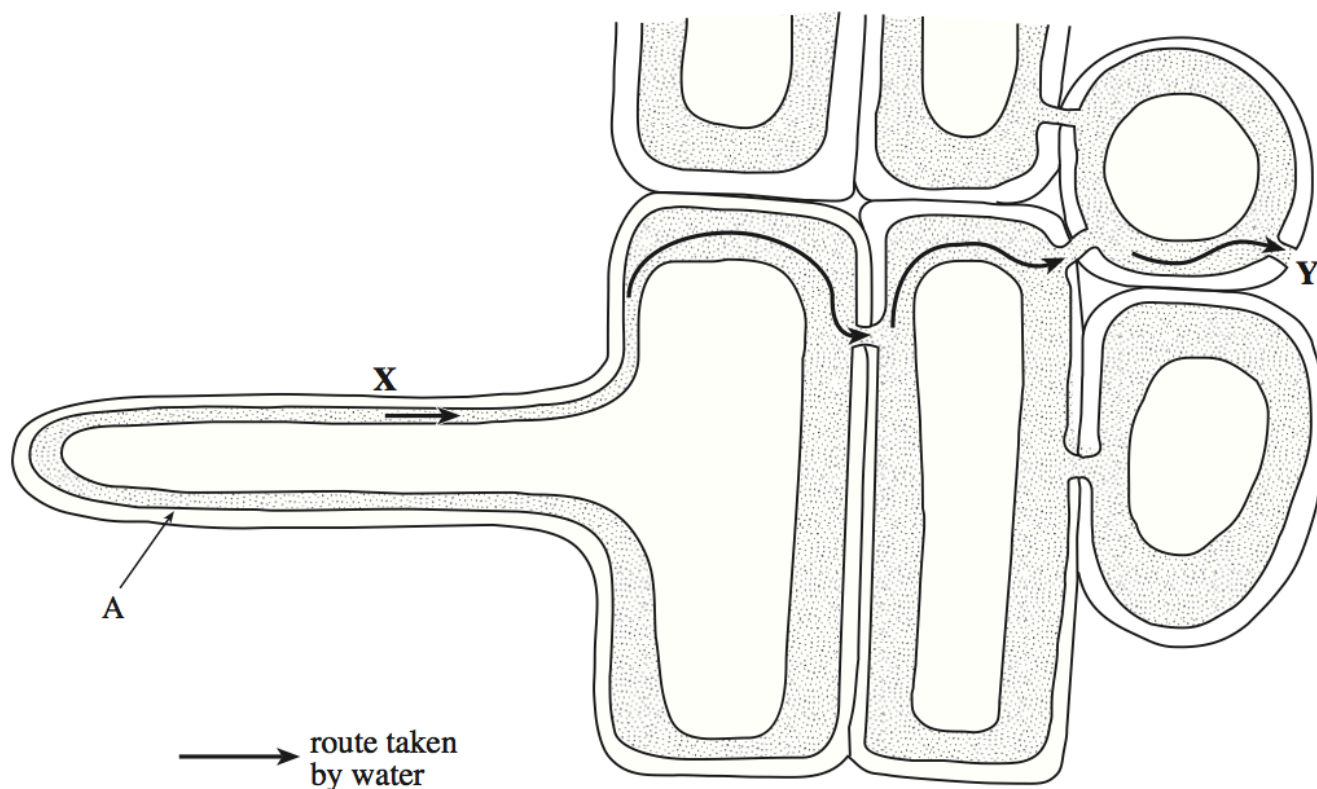
(ii) State the general name given to areas where unloading of carbohydrate occurs. [1]

.....

**(Total 6 Marks)**

20.

4. The diagram shows some cells in the root of a plant.



- (a) (i) Name cell A. [1]

.....

- (ii) How could nitrate ions enter the root if the concentration of nitrate ions outside the plant is less than the concentration inside cell A? [1]

.....

- (iii) Water moves from point X to point Y. What name is used to describe the pathway? [1]

.....

- (iv) Suggest how the Casparian strip in the endodermis may ensure the selective absorption of ions into the xylem of the root. [2]

.....

.....

.....

- (b) The table shows the relative rate of transpiration in two grasses of equal leaf surface area.

<i>Type of grass</i>	<i>Relative transpiration rate</i>
Meadow grass species	100
Marram grass species	42

State **two** adaptations of the Marram grass leaf to account for the difference in transpiration rate. [2]

- (i) .....
- .....
- (ii) .....
- .....

- (c) Transpiration may increase when stomata open. Describe the mechanism which causes stomata to open. [3]

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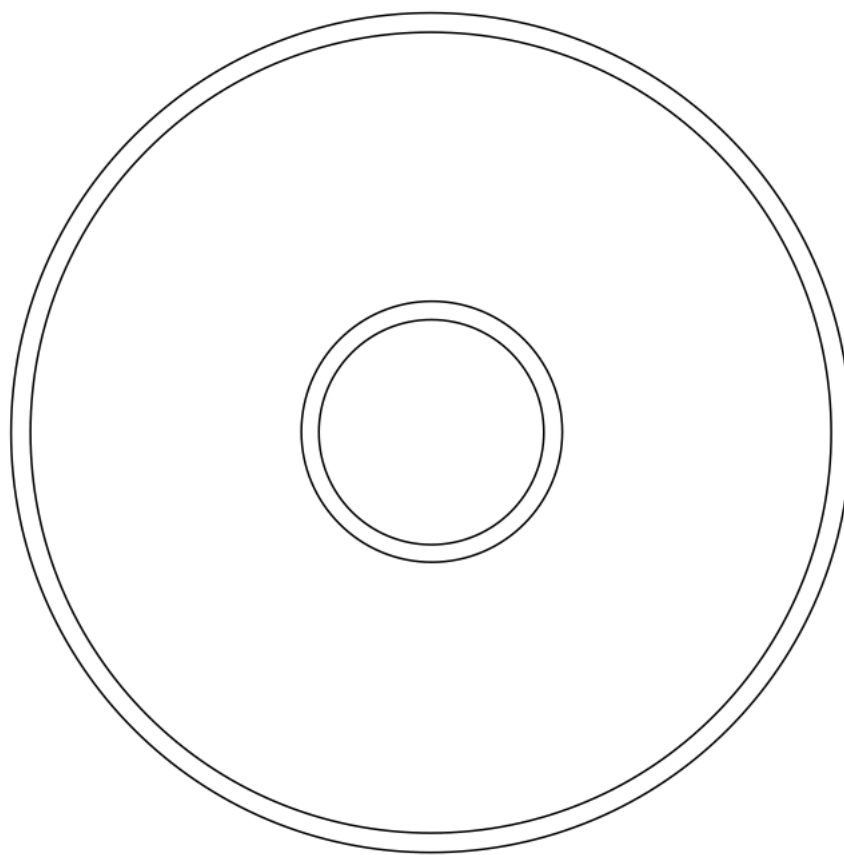
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**(Total 10 marks)**

21.

The diagram below shows a transverse section of the root of a dicotyledonous plant.



- (a) On the diagram, label the endodermis. [1]
- (b) Complete the diagram by drawing and labelling the xylem and the phloem. [2]
- (c) In the space below,
- (i) Draw a diagram of a single cell from the endodermis of a young root. [1]
- (ii) Annotate your drawing to explain the function of endodermis cells in the uptake of water. [3]
- (d) Describe how nitrogen moves from the soil to the xylem of the root. [3]

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**(Total 10 marks)**

22.

6. (a) Draw a clear line diagram showing a transverse section of a plant stem. [2]

Label and **name correctly** the tissues involved in:

A. water and mineral salt transport and; [1]

B. transport of sucrose and amino acids. [1]

- (b) Explain briefly how water and minerals enter and travel across the root cortex from the soil. [4]

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(Total 8 marks)



## Essays

1.

- (b) Plants have two distinct transport systems. Describe how the structure of each is adapted to its function. [10]

2.

- (b) Explain what is meant by transpiration. Describe the factors affecting transpiration. [7]

Describe how you could use a potometer to investigate one of these factors. [3]

3.

- (b) (i) Describe how the rate of transpiration is **increased** by external factors. [7]  
(ii) Describe and explain **three** features of the marram grass leaf that enable the plant to survive on sand dunes. [3]

(Total 10 marks)

4.

- (a) (i) Describe the structure of plant phloem tissue. [4]  
(ii) Discuss the transport of materials within the phloem. [6]

5.

- (a) (i) Describe how organic solutes are translocated in the phloem according to the mass flow hypothesis. [8]  
(ii) Outline the limitations of this hypothesis. [2]

6.

- (b) Describe the mass flow hypothesis of phloem transport. Suggest any limitations to this theory and name alternative hypotheses which have been proposed. [10]

7.

- (b) Describe how water passes from the soil to the xylem vessels of a root. [10]